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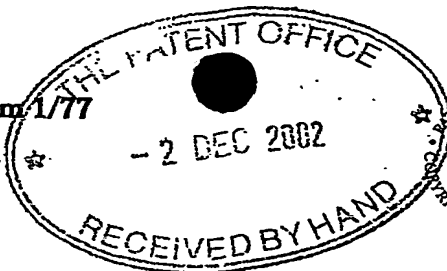
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1/77

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1. Your reference

P17121GB-NF/jsd

2. Patent application number

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0228054.3

03DEC02 E767901-2 D00389 02 DEC 2002
P01/7730 0.00 0228054.3

3. Full name, address and postcode of the or of each applicant (underline all surnames)

Autoliv Development AB,
Patent Department Sweden,
S-447 83 VARGARDA,
Sweden.

Patents ADP number (if you know it)

321018006

If the applicant is a corporate body, give the country/state of its incorporation

SWEDEN

4. Title of the invention

Improvements in or Relating to a Safety Arrangement for a Vehicle"

5. Name of your agent (if you have one)

Forrester Ketley & Co.

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

Forrester House
52 Bounds Green Road
London
N11 2EY

Patents ADP number (if you know it)

133001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number
(if you know it)

Date of filing
(day / month / year)

GB

0224429.1

21
22 October 2002

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

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1

Request for substantive examination (Patents Form 10/77)

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11. ☒ We request the grant of a patent on the basis of this application.

Signature *Forrester Kelly & Co* Date 2 December 2002
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PATENTS ACT 1977

P17121GB-NF/jsd

5

**"IMPROVEMENTS IN OR RELATING TO A SAFETY
ARRANGEMENT FOR A VEHICLE"**

10 **THIS INVENTION** relates to a safety arrangement for a vehicle, and in particular concerns an improved arrangement for detecting a crash situation and controlling at least one safety device, such as an air-bag.

15 Modern vehicle safety systems typically comprise a main control unit, which is the hub of the system. The main control unit comprises one or more accelerometers to measure the rate of change of velocity of the vehicle, a processor operable to perform a decision algorithm on the signals output by the accelerometers in order to establish whether a crash situation has occurred and implement a crash algorithm to activate one or more safety devices accordingly,
20 an energy source, normally in the form of one or more capacitors, storing sufficient ignition energy to activate the safety device, and an ignition circuit, which is controlled by the output of the crash algorithm, and which connects the capacitor(s) to the safety device(s) to deploy the safety device(s) upon detection of a crash situation. The control unit may also comprise means for
25 controlling the communications between the control unit and various external units, and have a diagnostic function.

Due to the fact that the control unit comprises accelerometers, the control unit must be physically located in a part of the vehicle where the sensed

acceleration will be representative of the acceleration of the vehicle as a whole. The ideal location for this purpose is the central tunnel of the vehicle, which comprises a ridge running along the centre of the floor of the chassis of the vehicle, and in many known systems the control unit is mounted on an upper
5 surface of the control tunnel, i.e. within the vehicle cabin.

Due to the number of components contained in the control unit, the control unit is rather large and heavy. It may, therefore, be difficult to allocate sufficient space to the control unit on the central tunnel of the vehicle, which
10 typically also carries other components such as the gear stick.

In addition, a heavy control unit will generate substantial vibration while the vehicle is moving, and this is likely to comprise the accuracy of the signal output by accelerometers provided therein.

15

It is an object of the present invention to alleviate one or more of the above difficulties.

Accordingly, one aspect of the present invention provides a vehicle
20 safety arrangement, the arrangement comprising: a sensor unit comprising at least one sensor responsive to acceleration, the sensor unit being located substantially along a central longitudinal line of the vehicle; an actuator for activating a safety device, the actuator being located remotely from the sensor unit; and a control unit located remotely from the sensor unit and from the
25 actuator, the control unit being operable to receive information from the sensor unit and to transmit an actuating command to the actuator to activate the safety device.

Advantageously, the control unit comprises no sensors responsive to acceleration.

Preferably, the sensor unit is located on a central tunnel of the vehicle.

5

Conveniently, the sensor unit comprises at least two sensors responsive to acceleration, which are configured to measure at least longitudinal and lateral acceleration of the vehicle.

10

Advantageously, the at least one sensor responsive to acceleration is configured to measure vertical acceleration of the vehicle.

Preferably, the sensor unit comprises a signal processor for sampling data gathered by sensors of the sensor unit.

15

Conveniently, the signal processor is operable to transmit the sampled data to the control unit.

Advantageously, the signal processor is operator to perform a crash algorithm, which causes the signal processor to instruct the control unit to transmit the actuating command to the actuator.

20

Alternatively, the signal processor is operable to receive the output of a decision algorithm, which determines whether the vehicle is in a crash situation.

25

Preferably, the decision algorithm is performed in the control unit.

Conveniently, the signal processor is operable to receive data from other remote sensors.

Advantageously, the sensor unit comprises one or more sensors operable
5 to measure an angular velocity of the vehicle around a longitudinal axis thereof.

Preferably, the actuator comprises an ignitor for igniting a charge to activate the safety device.

10 Conveniently, the control unit comprises one or more capacitors configured to store sufficient energy to cause the actuator to activate the safety device.

Advantageously, the discharge of the one or more capacitors comprises
15 the actuation command.

Preferably, the actuator is located in a unit that also comprises a capacitor configured to store energy to activate the safety device, the capacitor being discharged to activate the safety device in response to the actuation
20 command.

Conveniently, the safety arrangement further comprises at least one left side sensor on a left side of the vehicle and at least one right side sensor on a right side of the vehicle.

25

Advantageously, the control unit is connected to a main battery of the vehicle, and supplies power to the sensor unit and the actuator.

Preferably, the sensor unit has a smaller volume than that of the control unit.

Conveniently, the sensor unit has a volume less than half that of the control unit.

Advantageously, the sensor unit has a smaller mass than that of the control unit.

Preferably, the mass of the sensor unit is less than half that of the control unit.

Conveniently, the sensor unit provided on a single microchip.

Advantageously, the sensor unit comprises a processor.

In order that the present invention may be more readily understood, embodiments thereof will now be described, by way of example, with reference to the accompanying drawings, in which:

FIGURE 1 shows a first safety arrangement embodying the present invention;

FIGURE 2 shows a second safety arrangement embodying the present invention;

FIGURE 3 shows a third safety arrangement embodying the present invention; and

FIGURE 4 shows a fourth safety arrangement embodying the present invention.

5 Referring to Figure 1, a schematic representation of a first safety arrangement 1 embodying the present invention is shown. The first safety arrangement 1 comprises a control unit 2 which has a processor 3. The processor 3 is, as discussed above, operable to apply a decision algorithm to signals received from sensors (described below), to determine from these
10 signals whether a crash situation has occurred. Such algorithms are known in the art.

The control unit 2 further comprises an ignition circuit 4, which is operable to send an actuation command (in this case in the form of an ignition
15 energy pulse) to a safety device of the vehicle, for instance an air-bag, as will be described in more detail below. The ignition circuit 4 is connected to one or more substantial capacitors 5a, which are charged with sufficient energy to activate the safety device, and will transmit of the stored energy to the safety device upon receipt of a trigger signal from the processor 3. Alternatively, the
20 ignition energy could be taken directly from the vehicle battery, although the battery may become disconnected from the safety arrangement 1, which could result in a failure of the safety device to deploy.

Finally, the control unit 2 comprises a voltage regulator 5b, which
25 receives power from the vehicle battery 6, or from an alternative power source, and regulates the voltage for charging the capacitors but could also provide power to the processor 3, and other components of the first safety arrangement 1.

It will be appreciated that the control unit 2 will be relatively large and heavy, particularly due to the presence of the capacitors and the ignition circuit 4, which normally comprises two switches for each safety device. The switches are respectively closed in response to an arming signal and to the trigger signal.

The safety arrangement 1 further comprises a sensor unit 7, which comprises a pair of accelerometers 8,9, one of which is orientated so as to measure longitudinal acceleration a_x of the vehicle, and the other of which is orientated to measure lateral acceleration a_y of the vehicle. The sensor unit 7 comprises a signal processor 10, which receives outputs from the accelerometers 8,9 and manipulates the data to be in a suitable form for feeding to the processor 3 of the central unit 2.

Left and right sensors 11,12 (which may also be accelerometers) are also provided, separately from the sensor unit 7, and the left and right sensors 11,12 are configured to be located on respective left and right hand sides of the vehicle to provide additional information that may be useful in determining whether or not the vehicle has encountered a crash situation, or in providing information on the type of crash that has occurred.

The safety arrangement 1 also comprises one or more actuators 13, in the form (in this example) of squibs or other devices such as relays which, upon activation thereof may, by way of example, inflate air-bags and release belt pretensioners.

As discussed above, it is important for the sensor unit 7 to be physically located on the vehicle in a position where the sensed acceleration will be

representative of the acceleration of the vehicle as a whole. Hence, the sensor unit 7 is positioned substantially along a central longitudinal line of the vehicle. In advantageous embodiments of the invention, the sensor unit 7 is located on the central tunnel of the vehicle, and in such embodiments the sensor unit 7
5 may be directly attached by any suitable means to an upper or lower surface of the central tunnel, or to a covering thereof. The sensor unit 7 may be located within the cabin of the vehicle.

However, the control unit 2, which comprises rather heavier
10 components, is located remotely from the sensor unit 7 and indeed may be placed in any suitable location on the vehicle, not necessarily anywhere near the central longitudinal line thereof (e.g. on a different part of the tunnel or behind the dashboard).

15 The control unit 2 communicates with the sensor unit 7 over a sensor communication line 14, which may take any suitable form.

The remote location of the control unit 2 from the sensor unit 7 means that it is not necessary to house the control unit 2 in the central tunnel of the
20 vehicle, thus alleviating the difficulty discussed above.

In addition, the relatively large vibrations that the control unit 2 will undergo during movement of the vehicle will not affect the sensor unit 7, which will therefore provide more reliable data regarding the acceleration of the
25 vehicle.

The control unit 2 is also located remotely from the actuator 13, and communicates therewith over an activation communication line 15. As discussed above, the control unit 2 comprises an ignition circuit 4 connected to

capacitors 5a charged with sufficient energy to activate the actuator 13 (for instance, to activate one or more ignitors to ignite the squibs), and in this embodiment the activation communication line 15 may simply comprise a power line, with the control unit 2 initiating activation of the actuator 13 by
5 discharging the capacitors along the power line.

It will be appreciated that, with the above arrangement, the volume and mass of the components that are located in the sensor unit 7 on the central tunnel of the vehicle are kept to an absolute minimum, with the larger, more
10 massive components being conveniently located elsewhere in the vehicle in the control unit 2.

Figure 2 shows a second safety arrangement 16 embodying the present invention. Common components between the first safety arrangement 1
15 discussed above and the second safety arrangement 16 are designated by like reference numerals.

In the second safety arrangement 16, the processing unit 3 in the control unit 2 receives data from the left and right sensors 11,12, and performs signal
20 processing, the output of which is sent to the signal processor 10, which now implements the main crash algorithm and hence decides whether the safety device is to be deployed. The signal processor 10 will, upon receiving a signal from the processing unit 3, perform the crash algorithm, and will (if appropriate) instruct the ignition circuit 4 to send an actuation command to the
25 actuators 13.

The second safety arrangement 16 also comprises a third sensor 17 in the sensor unit 7, this third sensor 17 being positioned to allow measurement of movement of the vehicle around the roll axis (angular velocity, ω_x).

Figure 3 shows a third safety arrangement 18 embodying the present invention, components thereof that are in common with the first safety arrangement 1 described above being designated by common reference numerals.

The third safety arrangement 18 comprises further sensors 19, which measure parameters of the car other than the acceleration thereof. For instance, the further sensors 19 may detect whether seat belt buckles are engaged, or may otherwise detect the presence of an occupant in a given seat of the vehicle, for instance by the weight exerted on the seat, or may measure the position of the seat or a part thereof (such as the headrest). The further sensors 19 may also gather information relating to the speed of the vehicle. The information output by the further sensors 19 is passed to the control unit 2 via an information bus 20, which allows communication between the control unit 2 and any other remote crash sensors (for instance the left and right sensors 11,12) and the actuator 13.

The information gathered by the further sensors 19 allows the processing unit 3 of the control unit 2 to arrive at a more informed decision regarding whether to activate the safety device. For instance, if the further sensors 19 detect that the passenger seat of the vehicle is unoccupied during a crash, the control unit 2 may prevent the triggering of a passenger-side air-bag, since this is unlikely to offer protection to the occupants of the vehicle, and may hinder efforts to leave the vehicle, or remove people from the vehicle, following a crash.

Also, in the third safety arrangement 18, the sensor unit 7 is provided on a single microchip, and it will be appreciated that this arrangement further

reduces the size and mass of the components that are to be located in the central tunnel of the vehicle.

With reference to Figure 4, a fourth safety arrangement 21 embodying
5 the present invention is shown. The fourth safety arrangement 21 is similar to
the third safety arrangement 18, however each safety device is provided with a
unit comprising a capacitor 5a, an ignition circuit 4 and an actuator 13, and the
information bus 20 continuously transmits power from the control unit 2 to the
10 capacitors and other remote units of the arrangement 21, including for instance
the sensor unit 7. The bus 20 also transmits the actuation command, now in
form of a trigger signal, from the processing unit 3 to the ignition circuits. If an
arming switch is used in 4, an arming signal will also be sent. The sensor unit
could also comprise a vertical accelerometer 22 to measure vertical acceleration
15 a_z .

It will be understood that the present invention provides an improved
safety arrangement, providing favourable distribution of components around a
vehicle, while improving the accuracy with which a crash situation may be
detected.

20 In the present Specification "comprises" means "includes or consists of"
and "comprising" means "including or consisting of".

25 The features disclosed in the foregoing description, or the following
Claims, or the accompanying drawings, expressed in their specific forms or in
terms of a means for performing the disclosed function, or a method or process
for attaining the disclosed result, as appropriate, may, separately, or in any
combination of such features, be utilised for realising the invention in diverse
forms thereof.

CLAIMS:

5

1. A vehicle safety arrangement, the arrangement comprising:

a sensor unit comprising at least one sensor responsive to acceleration,
the sensor unit being located substantially along a central longitudinal line of
10 the vehicle;

an actuator for activating a safety device, the actuator being located
remotely from the sensor unit; and

a control unit located remotely from the sensor unit and from the
actuator, the control unit being operable to receive information from the sensor
15 unit and to transmit an actuating command to the actuator to activate the safety
device.

2. A safety arrangement according to Claim 1, wherein the control unit
comprises no sensors responsive to acceleration.

20

3. A safety arrangement according to Claims 1 or 2, wherein the sensor unit
is located on a central tunnel of the vehicle.

4. A safety device according to any preceding Claim, wherein the sensor
25 unit comprises at least two sensors responsive to acceleration, which are
configured to measure at least longitudinal and lateral acceleration of the
vehicle.

5. A safety arrangement according to any preceding Claim, wherein the at least one sensor responsive to acceleration is configured to measure vertical acceleration of the vehicle.
- 5 6. A safety arrangement according to any preceding Claim, wherein the sensor unit comprises a signal processor for sampling data gathered by sensors of the sensor unit.
7. A safety arrangement according to Claim 6, wherein the signal processor
10 is operable to transmit the sampled data to the control unit.
8. A safety arrangement according to Claim 6 or 7, wherein the signal processor is operator to perform a crash algorithm, which causes the signal processor to instruct the control unit to transmit the actuating command to the
15 actuator.
9. A safety arrangement according to Claim 6 or 7, wherein the signal processor is operable to receive the output of a decision algorithm, which determines whether the vehicle is in a crash situation.
20
10. A safety arrangement according to Claim 9, wherein the decision algorithm is performed in the control unit.
11. A safety arrangement according to any of Claims 6 to 10, wherein the
25 signal processor is operable to receive data from other remote sensors.
12. A safety arrangement according to any preceding Claim, wherein the sensor unit comprises one or more sensors operable to measure an angular velocity of the vehicle around a longitudinal axis thereof.

13. A safety arrangement according to any preceding Claim, wherein the actuator comprises an ignitor for igniting a charge to activate the safety device.
- 5 14. A safety arrangement according to any preceding Claim, wherein the control unit comprises one or more capacitors configured to store sufficient energy to cause the actuator to activate the safety device.
- 10 15. A safety arrangement according to Claim 14, wherein the discharge of the one or more capacitors comprises the actuation command.
- 15 16. A safety arrangement according to any preceding Claim, wherein the actuator is located in a unit that also comprises a capacitor configured to store energy to activate the safety device, the capacitor being discharged to activate the safety device in response to the actuation command.
- 20 17. A safety arrangement according to any preceding Claim, further comprising at least one left side sensor on a left side of the vehicle and at least one right side sensor on a right side of the vehicle.
18. A safety arrangement according to any preceding Claim, wherein the control unit is connected to a main battery of the vehicle, and supplies power to the sensor unit and the actuator.
- 25 19. A safety arrangement according to any preceding Claim, wherein the sensor unit has a smaller volume than that of the control unit.
20. A safety arrangement according to Claim 19, wherein the sensor unit has a volume less than half that of the control unit.

21. A safety arrangement according to any preceding Claim, wherein the sensor unit has a smaller mass than that of the control unit.
- 5 22. A safety arrangement according to Claim 21, wherein the mass of the sensor unit is less than half that of the control unit.
23. A safety arrangement according to any preceding Claim, wherein the sensor unit provided on a single microchip.
- 10 24. A safety arrangement according to any preceding Claim, wherein the sensor unit comprises a processor.
- 15 25. A vehicle comprising a safety arrangement according to any preceding Claim.
26. A safety arrangement substantially as hereinbefore described, with reference to the accompanying drawings.
- 20 27. Any novel feature or combination of features disclosed herein.

ABSTRACT

5 **“A SAFETY ARRANGEMENT FOR A VEHICLE”**

A vehicle safety arrangement, the arrangement comprising: a sensor unit (7) comprising at least one sensor (8, 9) responsive to acceleration; an actuator (13) for activating a safety device, the actuator being located remotely from the sensor unit; and a control unit (2) located remotely from the sensor unit and from the actuator, the control unit having no sensors responsive to acceleration and being operable to receive information from the sensor unit and to transmit an actuating command to the actuator to activate the safety device.

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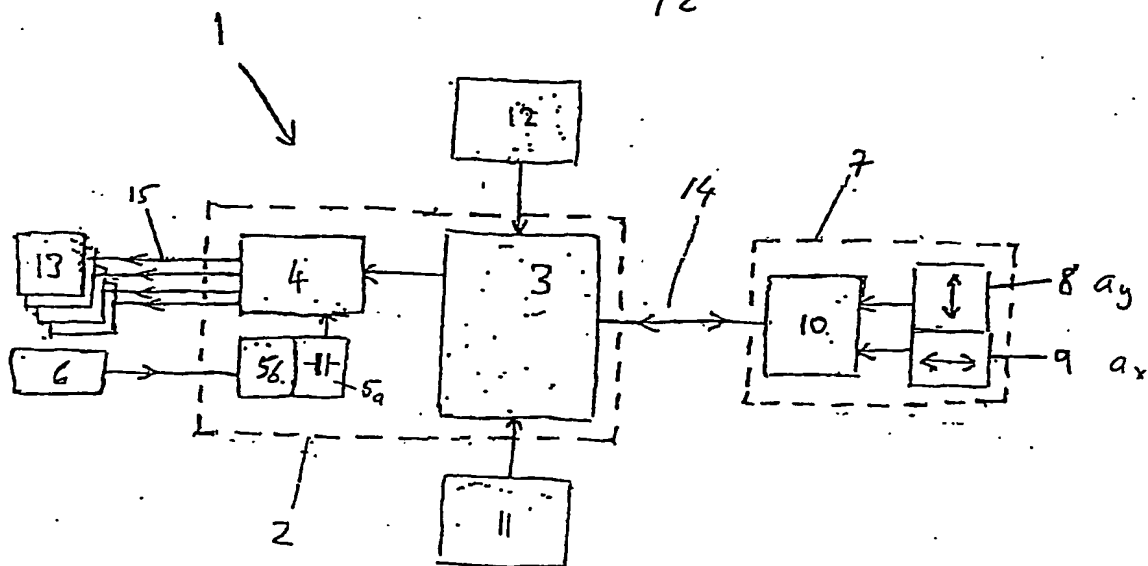


Fig 1

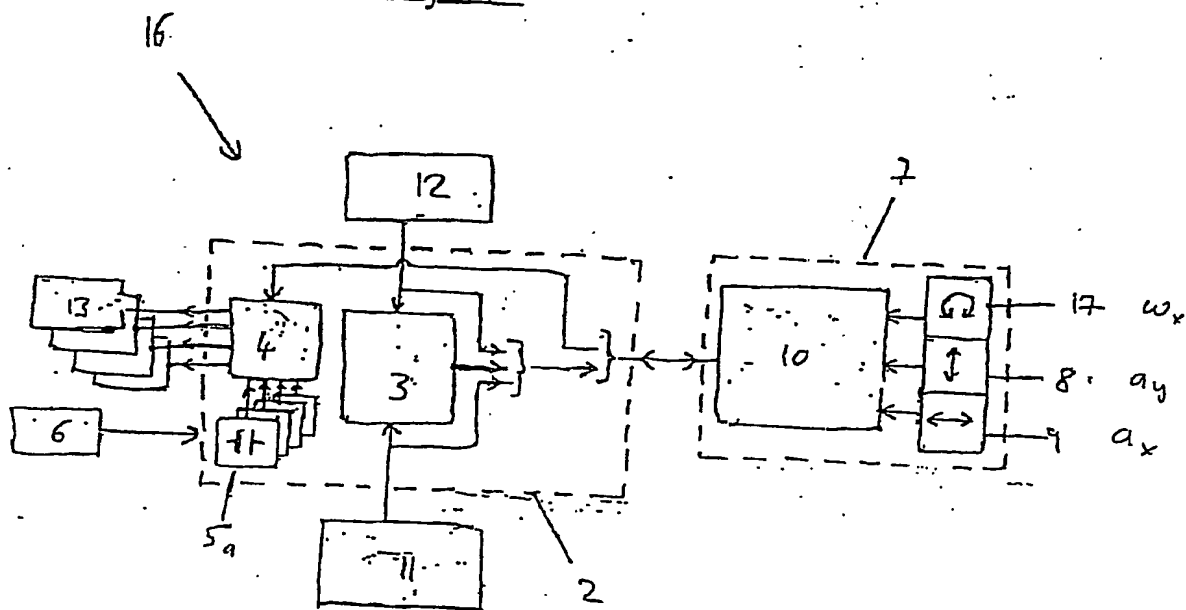


Fig 2

2/2

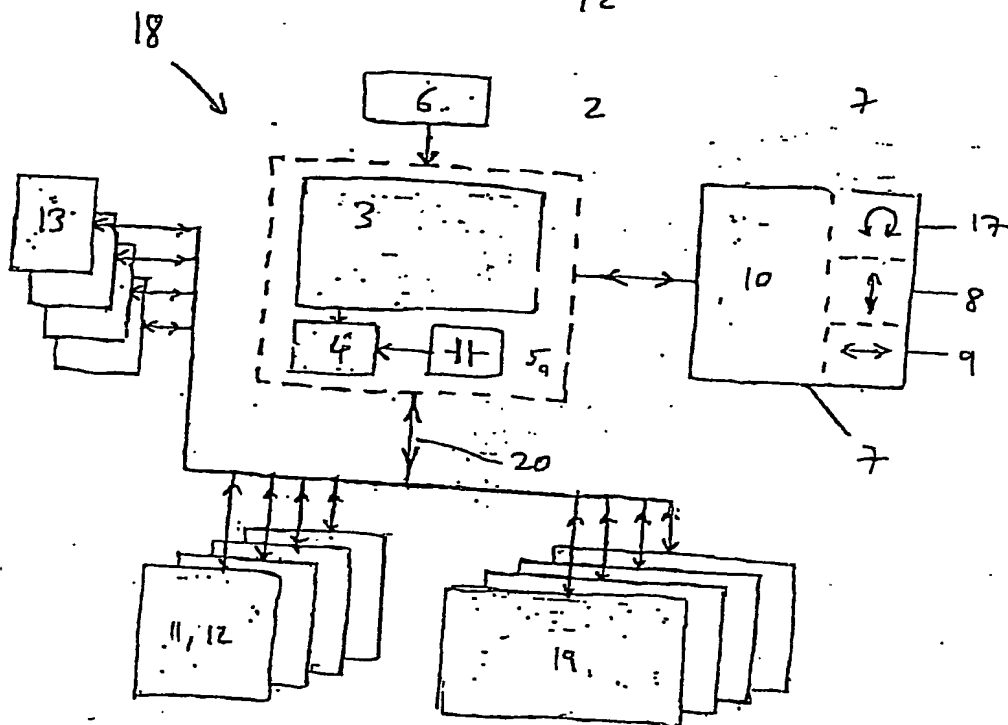


Fig 3

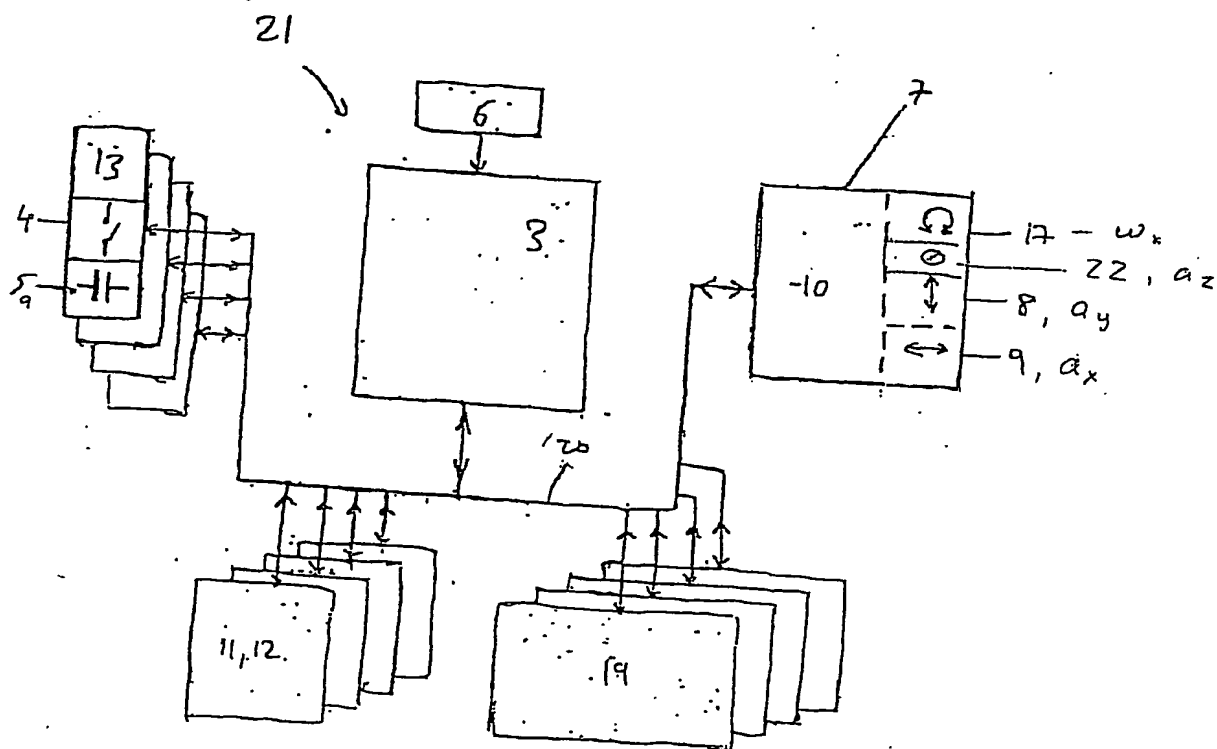


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